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UTILITY PATENT APPLICATION TRANSMITTAL <small>(Only for new nonprovisional applications under 37 CFR 1.53(b))</small>	Attorney Docket No.	834DAW
	First Inventor or Application Identifier	DAWSON, Tyler R.
	Title	Hub with integral key and integral...
	Express Mail Label No.	EF619560003US

APPLICATION ELEMENTS <small>See MPEP chapter 600 concerning utility patent application contents.</small>	ADDRESS TO: Assistant Commissioner for Patents Box Patent Application Washington, DC 20231
1. <input checked="" type="checkbox"/> * Fee Transmittal Form (e.g., PTO/SB/17) <small>(Submit an original, and a duplicate for fee processing)</small> 2. <input checked="" type="checkbox"/> Specification [Total Pages 19] <small>(preferred arrangement set forth below)</small> - Descriptive title of the Invention - Cross References to Related Applications - Statement Regarding Fed sponsored R & D - Reference to Microfiche Appendix - Background of the Invention - Brief Summary of the Invention - Brief Description of the Drawings (if filed) - Detailed Description - Claim(s) - Abstract of the Disclosure 3. <input checked="" type="checkbox"/> Drawing(s) (35 U.S.C. 113) [Total Sheets 6] 4. Oath or Declaration [Total Pages 2] a. <input type="checkbox"/> Newly executed (original or copy) b. <input checked="" type="checkbox"/> Copy from a prior application (37 C.F.R. § 1.63(d)) <small>(for continuation/divisional with Box 17 completed)</small> <small>[Note Box 5 below]</small> i. <input type="checkbox"/> DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b). 5. <input type="checkbox"/> Incorporation By Reference (useable if Box 4b is checked) The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered to be part of the disclosure of the accompanying application and is hereby incorporated by reference therein.	6. <input type="checkbox"/> Microfiche Computer Program (Appendix) 7. Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary) a. <input type="checkbox"/> Computer Readable Copy b. <input type="checkbox"/> Paper Copy (identical to computer copy) c. <input type="checkbox"/> Statement verifying identity of above copies
ACCOMPANYING APPLICATION PARTS 8. <input type="checkbox"/> Assignment Papers (cover sheet & document(s)) 9. <input type="checkbox"/> 37 C.F.R. §3.73(b) Statement <input type="checkbox"/> Power of Attorney <small>(when there is an assignee)</small> 10. <input type="checkbox"/> English Translation Document (if applicable) 11. <input type="checkbox"/> Information Disclosure Statement (IDS)/PTO-1449 <input type="checkbox"/> Copies of IDS Citations 12. <input type="checkbox"/> Preliminary Amendment 13. <input checked="" type="checkbox"/> Return Receipt Postcard (MPEP 503) <small>(Should be specifically itemized)</small> * Small Entity <input checked="" type="checkbox"/> Statement filed in prior application, Status still proper and desired (copy enclosed) 14. <input type="checkbox"/> Statement(s) <input checked="" type="checkbox"/> <small>(PTO/SB/09-12)</small> 15. <input type="checkbox"/> Certified Copy of Priority Document(s) <small>(if foreign priority is claimed)</small> 16. <input type="checkbox"/> Other: * A new statement is required to be entitled to pay small entity fees, except where one has been filed in a prior application and is being relied upon.	
17. If a CONTINUING APPLICATION , check appropriate box, and supply the requisite information below and in a preliminary amendment. <input type="checkbox"/> Continuation <input type="checkbox"/> Divisional <input type="checkbox"/> Continuation-in-part (CIP) of prior application No: Prior application information: Examiner: Group / Art Unit:	

18. CORRESPONDENCE ADDRESS <input checked="" type="checkbox"/> Customer Number or Bar Code Label (Insert Custom) PATENT & TRADEMARK OFFICE or <input type="checkbox"/> Correspondence address below					
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Signature	<i>T. R. Touw</i>	Date	02/26/99

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FEE TRANSMITTAL

Patent fees are subject to annual revision on October 1.

These are the fees effective October 1, 1997.

Small Entity payments must be supported by a small entity statement, otherwise large entity fees must be paid. See Forms PTO/SB/09-12.**Complete if Known**

Application Number

Filing Date

FEB. 26, 1999

First Named Inventor

DAWSON, Tyler R.

Examiner Name

Group / Art Unit

Attorney Docket No.

834DAW

TOTAL AMOUNT OF PAYMENT

(\$ 497.00)

METHOD OF PAYMENT (check one)

- 1.
- ☐
- The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

Deposit
Account
Number
Deposit
Account
Name

20-1397

Theodore R. Touw

☒ Charge Any Additional
Fee Required Under
37 CFR 1.16 and 1.17☐ Charge the Issue Fee Set in
37 CFR 1.18 at the Mailing of the
Notice of Allowance

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Large Entity Fee Code	Small Entity Fee Code	Fee Description	Fee Paid
101	790	201 395 Utility filing fee	380
106	330	206 165 Design filing fee	
107	540	207 270 Plant filing fee	
108	790	208 395 Reissue filing fee	
114	150	214 75 Provisional filing fee	

SUBTOTAL (1) (\$ 380.00)

2. EXTRA CLAIM FEES

Total Claims	Extra Claims	Fee from below	Fee Paid
33	-20** = 13	X 9	= 117
Independent Claims	2	- 3** =	
Multiple Dependent			

**or number previously paid, if greater; For Reissues, see below

Large Entity Fee Code	Small Entity Fee Code	Fee Description
103	22	203 11 Claims in excess of 20
102	82	202 41 Independent claims in excess of 3
104	270	204 135 Multiple dependent claim, if not paid
109	82	209 41 ** Reissue independent claims over original patent
110	22	210 11 ** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) (\$ 117.00)

FEE CALCULATION (continued)**3. ADDITIONAL FEES**

Large Entity Fee Code	Small Entity Fee Code	Fee Description	Fee Paid
105	130	205 65 Surcharge - late filing fee or oath	
127	50	227 25 Surcharge - late provisional filing fee or cover sheet.	
139	130	139 130 Non-English specification	
147	2,520	147 2,520 For filing a request for reexamination	
112	920*	112 920* Requesting publication of SIR prior to Examiner action	
113	1,840*	113 1,840* Requesting publication of SIR after Examiner action	
115	110	215 55 Extension for reply within first month	
116	400	216 200 Extension for reply within second month	
117	950	217 475 Extension for reply within third month	
118	1,510	218 755 Extension for reply within fourth month	
128	2,060	228 1,030 Extension for reply within fifth month	
119	310	219 155 Notice of Appeal	
120	310	220 155 Filing a brief in support of an appeal	
121	270	221 135 Request for oral hearing	
138	1,510	138 1,510 Petition to institute a public use proceeding	
140	110	240 55 Petition to revive - unavoidable	
141	1,320	241 660 Petition to revive - unintentional	
142	1,320	242 660 Utility issue fee (or reissue)	
143	450	243 225 Design issue fee	
144	670	244 335 Plant issue fee	
122	130	122 130 Petitions to the Commissioner	
123	50	123 50 Petitions related to provisional applications	
126	240	126 240 Submission of Information Disclosure Stmt	
581	40	581 40 Recording each patent assignment per property (times number of properties)	
146	790	246 395 Filing a submission after final rejection (37 CFR 1.129(a))	
149	790	249 395 For each additional invention to be examined (37 CFR 1.129(b))	

Other fee (specify) _____

Other fee (specify) _____

* Reduced by Basic Filing Fee Paid

SUBTOTAL (3) (\$)

SUBMITTED BYTyped or
Printed Name

Theodore R. Touw

Signature



Date

02/26/99

Complete (if applicable)

Reg. Number

36,702

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**STATEMENT CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) & 1.27(c))--SMALL BUSINESS CONCERN**

Docket Number (Optional)
834DAW-PPA

Applicant, Patentee, or Identifier: Tyler R. Dawson
Application or Patent No.: _____
Filed or Issued: filed herewith
Title: HUB WITH INTEGRAL KEY AND INTEGRAL POSITIONING STOP

I hereby state that I am

- ☐ the owner of the small business concern identified below:
☒ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF SMALL BUSINESS CONCERN Vermont Ware, Inc.

ADDRESS OF SMALL BUSINESS CONCERN P.O. Box 490
Hinesburg, VT 05461

I hereby state that the above identified small business concern qualifies as a small business concern as defined in 13 CFR Part 121 for purposes of paying reduced fees to the United States Patent and Trademark Office, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time, or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby state that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention described in:

- ☒ the specification filed herewith with title as listed above.
☐ the application identified above.
☐ the patent identified above.

If the rights held by the above identified small business concern are not exclusive, each individual, concern, or organization having rights in the invention must file separate statements as to their status as small entities, and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e).

- Each person, concern, or organization having any rights in the invention is listed below:
☒ no such person, concern, or organization exists.
☐ each such person, concern, or organization is listed below.

Separate statements are required from each named person concern or organization having rights to the invention stating their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

NAME OF PERSON SIGNING Tyler R. Dawson

TITLE OF PERSON IF OTHER THAN OWNER Vice President

ADDRESS OF PERSON SIGNING 349 Highlands Drive, Williston, VT 05495

SIGNATURE  DATE 2-10-99

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
APPLICATION FOR PATENT UNDER 37 CFR §1.53(b)(1)

TITLE OF THE INVENTION

Hub with Integral Key and Integral Positioning Stop

CROSS REFERENCE TO RELATED APPLICATIONS

This application is related to Provisional Patent Application Ser. No. 60/119,554, filed in the United States Patent and Trademark Office on February 10, 1999.

FIELD OF THE INVENTION

This invention relates generally to a hub for a pulley, gear, or wheel. More particularly, it relates to such a hub formed with an integral key or other integral means for preventing relative rotation and with an integral stop for positioning the hub axially on a shaft.

BACKGROUND OF THE INVENTION

Pulleys have been made by various processes, including casting or machining of the entire pulley and casting or machining of only a tubular boss or hub, and attachment to that tubular boss or hub of a generally disk-shaped body portion, the latter being made by pressing or stamping from metal plate. Pulleys made by the latter methods often have a belt-mounting portion formed by attaching two generally dish-shaped body portions together back-to-back. For many applications, gears may be made by similar methods, with additional steps for cutting gear teeth. The hubs of both pulleys and gears are often made with a keyway machined to extend radially outward from their inner walls for fitting of a key used with a shaft having a keyway machined radially inward from its outer circumference.

DESCRIPTION OF THE RELATED ART

U.S. Pat. No. 1,266,579 to Garcelon discloses a pulley fabricated by using a hub and welding disks to the hub to form a pulley.

5 U.S. Pat. No. 3,324,735 to Hanke discloses a pulley fabricated using sheet metal, with elements projecting radially inward from a tubular member. The elements are tapped for setscrews to engage the shaft.

10 U.S. Pat. No. 4,059,023 to Sproul discloses a one-piece sintered pulley hub construction formed of powder metal with a pair of radially outwardly extending hub pulling flanges. The hub has a generally tubular-shaped body with front and rear end faces and a cylindrical bore extending axially between them. The pulling flanges are formed integrally with the tubular body and extend radially outward from near the front end of the tubular body in diametrically opposite directions, with the front surfaces of the flanges preferably lying in the same plane with the front end face of the tubular body.
15 The flanges provide lugs for gripping by a hub-pulling device, and they enable the hub to be formed in one piece by a powder metal sintering process.

20 U.S. Pat. Nos. 4,056,014 and 4,090,284 to Kraft discloses a method of making a sintered pulley hub construction for mounting on a bottom wall of a sheet metal pulley cup. A pair of tubular members is pressure-formed in a green compact state from a metal powder mixture. One of the members has a cylindrical body which terminates at one end in an outwardly extending annular flange which forms a hub pulling flange. The other member has an interior annular cavity formed in one end and a radially outwardly extending annular flange formed on the other end. The cylindrical body of the one member is telescopically received within the annular cavity of the other member.
25 The members are joined by sintering to form an integral homogeneous body. The method of

forming the improved hub includes the steps of separately pressure-forming each of the tubular members in a green compact state in a pair of molds.

U.S. Pat. No. 4,226,134 to Sohnle discloses a belt pulley constructed using two substantially identical stamped sheet metal halves which are so configured as to define a
5 hub region when assembled. One or both of the pulley halves may be provided with a radially inwardly extending nose which engages a key-way on the shaft on which it is mounted, for preventing relative rotation of pulley and shaft.

U.S. Pat. No. 4,220,372 to Johansen et al. discloses a dual wheel and axle assembly having a wedge lock hub and axle assembly with an auxiliary clamp to augment
10 the grip of the hub on the drive axle. A drive is provided to force bushing segments between the wheel hub and the drive axle to firmly lock the wheel hub and axle together. One of the bushing segments has an extension which extends axially along the drive shaft and carries a clamp in the form of at least one U-bolt having curvature mating that of the peripheral surface of the drive axle. The U-bolt is firmly clamped against a portion of the
15 drive axle while the extension of the bushing segment which has an integral key firmly seats in a key slot of the drive axle to augment the grip of the wheel hub on the drive axle to accommodate additional torque produced by adding dual wheels to a conventional single wheel drive on a tractor.

U.S. Pat. Reissue No. RE32,125 to Von Kaler et al. discloses a transmission for
20 changing speed, with a shift mechanism which selectively couples a plurality of change gears one at a time to a shaft on which the gears are journaled. The shift mechanism is disposed entirely within the transmission housing and includes a shift key arranged for axial sliding movement in a groove in the shaft. Change gears have four integral arcuate teeth, extending inward, to journal the gear on a shaft. The axial dimension of each tooth
25 is slightly less than half the axial dimension of the gear.

U.S. Pat. No. 4,525,094 to Johnson et al. discloses a split-flanged circular bushing to be used to secure driving or driven elements such as sheaves, pulleys, and the like, to a rotatable shaft. The bushing has an integrally formed key in its center opening for insertion into a corresponding keyway in the shaft. The bushing is formed in a sintering operation. Increased density is imparted to fillets or junctions between the flange and the outer wall of the body, thereby providing increased resistance to stress fatigue in these critical areas. Fillets between the key and the inner wall of the body are provided to distribute the stress concentration inherent in these areas.

U.S. Pat. No. 5,527,227 to Asai et al. discloses a pulley made from a metal plate by using a press forming technique. The pulley has a thin tubular boss portion and a disk-shaped body portion which are integral. The boss portion may have a reinforcing flange at one open end portion. The reinforcing flange aids in providing sufficient strength against the tightening force of a nut which is screwed onto a shaft inserted into the boss portion and also disperses the tightening force. The pulley may have a key member formed integrally on the boss portion.

U.S. Pat. No. 5,720,685 to Malone shows a molded plastic pulley and stub shaft for the drive train of a clothes-washing machine. A plastic pulley and stub shaft are integrally formed with one another and used as a unitary component in the drive train of the clothes washing machine. The pulley has a co-axial bore on one side for receiving a motor shaft of an electric motor. The pulley also has a circumferential groove configured for receiving a belt. The stub shaft extends co-axially from the opposite side of the pulley as the bore.

PROBLEMS SOLVED BY THE INVENTION

In the assembly of machines using pulleys, the pulleys are sometimes misaligned relative to the ends of their shafts and keys are sometimes inadvertently omitted or lost.

Similar problems occur in the use of gears. There is a need for pulleys or gears made to prevent such assembly errors and to improve speed and efficiency of assembling machines.

OBJECTS AND ADVANTAGES OF THE INVENTION

5 A major object of the invention is to provide a pulley or gear that has integral means for preventing relative rotation such as an integral key and preferably has an integral stop, to prevent errors in assembly of the pulley or gear on a shaft and to allow rapid, properly aligned assembly. Another object is providing a pulley or gear requiring a reduced number of separate parts, thus reducing inventory-keeping and preventing loss of
10 small individual parts.

SUMMARY OF THE INVENTION

A hub for a pulley, gear, or wheel is formed with an integral key or other integral means for preventing relative rotation and with an integral stop for positioning the hub
15 axially on a shaft. The hub has a generally cylindrical (or polygonal) opening for a shaft, an integral key extending inwardly into the shaft opening along at least part of the shaft opening for engaging a keyway in the shaft, and an integral mechanical stop covering at least a portion of one end of the shaft opening. The integral key preferably extends the entire length of the shaft opening. The mechanical stop preferably has an opening which
20 is disposed at least around one end of the integral key. The mechanical stop serves to position the pulley, gear, or wheel precisely with respect to the end of a shaft when the pulley, gear, or wheel is assembled onto the shaft. The keyed hub is manufactured by powder metallurgy. One or more body plates are welded or glued to the formed hub to form a pulley, gear, or wheel, or the hub is pressed into a body plate. The shaft opening

may be formed with an integral flat or with a polygonal or splined cross-section to prevent rotation of the hub on its shaft, instead of, or in addition to, the integral key.

BRIEF DESCRIPTION OF THE DRAWINGS

5 FIG. 1 is a perspective view of a hub for a pulley made in accordance with the invention.

FIG. 2 is a perspective view of the hub of FIG. 1 shown from a viewpoint differing from FIG. 1.

10 FIG. 3 is a side elevation partially cutaway view of a pulley made in accordance with the invention.

FIG. 4 is a plan view of a pulley made in accordance with the invention.

FIG. 5 is a plan view of a gear made in accordance with the invention.

FIG. 6 is a perspective view of a second embodiment of a hub.

15 FIG. 7 is a side elevation partially cutaway view of a pulley having the hub embodiment of FIG. 6.

FIG. 8 is a plan view of a pulley made with the hub embodiment of FIG. 6.

FIG. 9 is a plan view of a gear made with the hub embodiment of FIG. 6.

FIG. 10 is a plan view of another embodiment of a hub made in accordance with the invention.

20 FIG. 11 is a plan view of another embodiment of the hub.

FIG. 12 is a plan view of another embodiment of the hub.

FIG. 13 is a plan view of a wheel having a hub made in accordance with the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. 1 and 2 show perspective views from different viewpoints of a first embodiment of a hub **10** for a pulley or gear made in accordance with the invention. FIG. 3 shows a partially cutaway side elevation view, and FIG. 4 shows a plan view of a pulley made with hub **10**. Hub **10** has an opening **20** for a shaft, an integral key **30** for engaging a keyway in the shaft, and an integral mechanical stop **40** extending across at least a portion of one end of opening **20**. Mechanical stop **40** serves to position the pulley precisely with respect to the end of a shaft when the pulley is assembled onto the shaft. Integral key **30** preferably extends substantially the entire length of opening **20** of hub **10**, as shown in cross-section in FIG. 3. Integral key **30** prevents hub **10** from turning relative to its shaft when assembled onto the shaft. Integral stop **40** may have an opening extending through it and communicating with opening **20**, such as generally circular opening **50**. In the embodiment shown in FIGS. 1 - 4, circular opening **50** is concentric with opening **20**. Also shown in FIGS. 1 and 4 is an opening portion **60** which communicates with opening **20** and is preferably aligned with one end of integral key **30** so that end of integral key **30** has opening portion **60** around it. Integral key **30** extends into opening portion **60**. As shown in FIG. 1 and 4, the overall shape of opening portion **60** is a "pie shape," i.e., a sector of a circle, bounded by radii defining a sector angle and by the arc subtended by that sector angle.

Hub **10** may have a reduced-diameter portion **45** of suitable depth and width to accommodate attachment of a disk-shaped body **80** against a shoulder. FIGS. 3 and 4 show a pulley having a disk-shaped body **80** affixed by weld **90** to hub **10** at the reduced-diameter portion **45** of hub **10**. For making such a pulley the disk-shaped body has a

circular rim formed with a peripheral recess for receiving a pulley belt. Also shown in FIG. 3 are circular rim 70 and a peripheral belt-receiving recess 75.

FIG. 5 is a plan view of a gear 100 made in accordance with the invention, with the same hub 10 as in FIGS. 1 - 4, but having gear teeth 110 cut in its rim. In the gear FIG. 5, additional openings 120 are formed in disk-shaped body 80, to reduce weight.

Hub 10 may have a conventional threaded setscrew hole (not shown) for attaching the hub to its shaft with a conventional setscrew. Similarly, a conventional through bolt may be employed. However, in a preferred embodiment for many applications, the setscrew is eliminated by the following arrangement. Made with a suitable diameter, opening 50 in FIGS. 1, 3, and 5 may be used for a conventional bolt (not shown) employed to fasten hub 10 onto a shaft having a tapped (internally threaded) hole in the shaft's end. Thus opening 50 provides access to the internally threaded hole by a conventional bolt for fastening the hub to the shaft, with or without an additional flat washer. The shaft may be polygonal, e.g. square, hexagonal, octagonal, etc.

Hub 10 may be cast or machined from steel, but is preferably made by a conventional powder metallurgy process of pressing and sintering metal powder. Generally in such a powder metallurgy process, blended metal powders of suitable composition, particle size, and particle shape are fed into a mold or die, compacted into the desired hub shape, ejected from the die and then sintered (solid state diffused) at a temperature below the melting point of the base material in a controlled atmosphere furnace. The compaction step requires the hub be removable from the die in the vertical direction with no cross movements of the tool members. The sintering step creates metallurgical bonds between the powder particles imparting the necessary mechanical and physical properties to the hub. The steps may be stated as providing a mold shaped to form the hub, filling the mold with metal powder of suitable composition, particle size, and particle shape, compacting the metal powder in the mold at suitable time and pressure

to form a preform, removing the preform from the mold, providing a suitable (non-oxidizing) atmosphere, and applying heat to the preform at suitable time and temperature in the non-oxidizing atmosphere to sinter the metal powder. The metal powder is preferably nickel steel powder having a composition by weight of 91.9% to 98.7% Fe, 1.0% to 3.0% Ni, 0.3% to 0.6% C, zero to 2.5% Cu, with any other additional elements amounting to no more than 2.0% maximum. Such a composition corresponds to material designation code FN-0205-20 in the MPIF Standard 35 "Materials Standards for P/M Structural Parts" available from the Metal Powder Industries Federation of Princeton, New Jersey (info@mpif.org).

Opening **50**, or at least opening portion **60** surrounding one end of integral key **30**, helps to prevent undue stress concentrations near the end of integral key **30** that is adjacent to integral stop **40**. Such opening arrangements are not necessary, however, for a successful powder metallurgy process for making hub **10**.

The advantages of this method for making the hub include the fact that it has the lowest cost of common powder metallurgy manufacturing methods, with modest tooling cost, the fact that little or no secondary machining is required, and the fact that the hub can be made with close tolerances. The same general powder metallurgy manufacturing method can be used with a variety of materials.

Body **80** may be made by metal casting, by spinning, by machining metal stock, by pressing or stamping sheet metal, or by any other suitable method.

FIGS. 6 - 8 illustrate a second, preferred embodiment of the invention. FIG. 6 is a perspective view of a second embodiment of a hub **10**. The end of hub **10** not shown in FIG. 6 is the same as FIG. 2. FIG. 7 is a side elevation partially cutaway view and FIG. 8 is a plan view of a pulley having the hub embodiment of FIG. 6. FIG. 9 is a plan view of a gear made with the hub embodiment of FIG. 6. The main feature distinguishing the

embodiment of FIG. 6 from that of FIGS. 1 - 5 is the form of opening **50** in integral stop **40**. In FIGS. 6 - 9, opening **50** has a generally circular form, except for a segment bounded by a flat edge **55**. Opening **50** of this embodiment still passes through integral stop **40**, communicates with opening **20** for the shaft, and is partially aligned with one end of integral key **30**. Made with a suitable diameter, opening **50** in FIGS. 6 - 9 allows for a bolt that can be used to fasten hub **10** onto a shaft having an internally threaded hole in the shaft's end, with or without an additional flat washer.

FIG. 10 is a plan view of another embodiment of a hub made in accordance with the invention. In FIG. 10, the integral key **30** is replaced by an integral flat **31**, which preferably extends substantially the entire length of opening **20** of hub **10**, as the integral key **30** shown in cross-section in FIG. 3 does. Integral flat **31** performs a similar function as integral key **30** in preventing hub **10** from turning relative to its shaft when assembled onto the shaft.

FIG. 11 is a plan view of another embodiment of the hub. Hub **10** of FIG. 11 has a shaft opening **20** having a polygonal form, e.g. hexagonal. It will be apparent to those skilled in the art that the flat portions of the polygonal shaft opening **21** in FIG. 11 perform the same function as integral flat **31** of FIG. 10 or integral key **30** of FIGS. 1 - 9, viz. preventing hub **10** from turning relative to its shaft when assembled onto a correspondingly shaped shaft. Polygonal shaft opening **21** may have any polygonal shape, for example, square, pentagonal, hexagonal, octagonal, etc.

FIG. 12 is a plan view of another embodiment of the hub. Hub **10** of FIG. 12 has a shaft opening **22** having a splined form, i.e. shaft opening **20** has integral splines **32**, which function as a multiplicity of integral keys **30** in preventing hub **10** from turning relative to its shaft when assembled onto the shaft.

FIG. 13 is a plan view of a wheel **130** having a hub **10** made in accordance with the invention. FIG. 13 illustrates another method of affixing hub **10** to body **80**, viz. by pressing instead of by welding. This method of affixing hub **10** to body **80** can also be used for a pulley or gear in some applications. The hub of wheel **130** is made with an outer peripheral surface portion **140** fitting tightly within a similarly shaped opening **150** in body **80**, and affixed to body **80** by pressing. Outer peripheral surface portion **140** and, correspondingly opening **150**, have a form and dimensions suitable for preventing relative rotation of hub **10** and body **80**. Outer peripheral surface portion **140** and, correspondingly opening **150**, may have any of various forms of right circular cylindrical, elliptical cylindrical, pyramidal, conical, or splined forms, for example, as alternatives to a form such as that shown in FIG. 13. Any suitable shape of outer peripheral surface portion **140** of hub **10** is formed with a suitable powder metallurgy mold or die. The corresponding opening **150** in body **80** may be formed in a complementary matching shape by casting or machining, for example. Although FIG. 13 is drawn for clarity with a visible gap between outer peripheral surface portion **140** of hub **10** and opening **150** in body **80**, the dimensions and their tolerances should be suitable for pressing, i.e. to provide a tight press fit.

Thus, from one aspect, the invention is a hub for a pulley, gear, or wheel, the hub having a shaft opening for a shaft that may have a keyway, the shaft opening having an inner surface and first and second ends, where the hub comprises integral means for preventing relative rotation, such as an integral key extending radially inward from the inner surface of the shaft opening for engaging the keyway when the hub is disposed on the shaft, and an integral stop extending across at least a portion of either the first or second end of the shaft opening, for preventing the shaft from extending beyond the hub when the hub is disposed on the shaft. Thus the integral stop serves to position a pulley, gear, or wheel having such a hub precisely with respect to the end of the shaft. Thus,

also, a pulley's recess for receiving a pulley belt (or the medial plane of a gear's teeth) is aligned to a plane at a known distance from the end of the shaft when the pulley (or gear) is assembled onto the shaft.

INDUSTRIAL APPLICABILITY

5 The invention has many uses in the fields of automotive equipment, appliances, power tools, hydraulic equipment, lawn and garden machines, agriculture, industrial manufacturing equipment, motors, recreational and exercise equipment, business equipment, and in many other fields which use pulleys or gears. The integral key and integral stop help to prevent errors in assembly of a pulley or gear on a shaft and allow
10 rapid, properly aligned assembly with automatic location on the shaft. The invention has a minimum number of separate parts, thus reducing inventory-keeping and preventing loss of small individual parts.

From the foregoing description of specific embodiments, one skilled in the art can easily ascertain the essential characteristics of this invention, and without departing from
15 the spirit and scope thereof, can make various changes and modifications of the invention to adapt it to various usages and conditions.

Other embodiments of the invention will be apparent to those skilled in the art from a consideration of this specification or from practice of the invention disclosed herein. For example, for light loads, both hub 10 and all other parts can be cast, molded,
20 or machined from plastic materials such as nylon, for example, instead of from the metals used in the embodiments described herein. For some applications, the invention may be made of ceramic by using conventional ceramic manufacturing methods. The hub may be affixed, e.g. by adhesive, or may be molded integrally in a molded part having a hub, a body plate, and a rim suitable for a particular use as a pulley, gear, or wheel. It is

intended that the specification and examples be considered as exemplary only, with the true scope and spirit of the invention being defined by the following claims.

Accordingly, the scope of the invention should be determined not by the
5 embodiments illustrated, but by the appended claims and their legal equivalents. The following claims are intended to be representative, but not exhaustive, of claims to be asserted in a utility patent application claiming priority of the present provisional patent application.

10 Having described my invention, I claim:

CLAIMS

1. A hub for a pulley, gear, or wheel, said hub having a first opening for a shaft having a keyway, said first opening having an inner surface and first and second ends, said
5 hub comprising:
- a) an integral key extending radially inward from said inner surface of said first opening for engaging said keyway when said hub is disposed on said shaft, and
- b) an integral stop extending across at least a portion of one of said first and second ends of said first opening, for preventing said shaft from extending beyond said
10 hub when said hub is disposed on said shaft.
2. A hub as recited in claim 1, wherein said integral key extends from said first end to said second end of said first opening.
3. A hub as recited in claim 1, further comprising a second opening extending through said integral stop, said second opening communicating with said first opening.
- 15 4. A hub as recited in claim 3, wherein said shaft has an end and said shaft has a tapped hole in said end, whereby said second opening provides access to said tapped hole by a bolt for fastening said hub to said shaft.
5. A hub as recited in claim 3, wherein said second opening is at least partially aligned with said integral key.
- 20 6. A hub as recited in claim 3, wherein said integral key extends at least into said second opening.
7. A hub as recited in claim 6, wherein said second opening has a round shape and said second opening is disposed concentrically with said first opening.

8. A hub as recited in claim 6, wherein at least a portion of said second opening has a pie shape and the pie-shaped portion of said second opening is disposed concentrically with said integral key.
9. A hub as recited in claim 6, wherein said integral stop extends across only a portion of one of said first and second ends of said first opening, said integral stop being bounded by a chord extending across said one of said first and second ends of said first opening, said second opening having a segment shape bounded by said chord.
10. A hub as recited in claim 9, wherein said second opening is disposed concentrically with said integral key.
11. A hub as recited in claim 3, wherein said integral key extends through said second opening.
12. A hub as recited in claim 3, wherein said second opening is circular and said second opening has a diameter smaller than said first opening.
13. A hub as recited in claim 12, wherein said second opening is concentric with said first opening.
14. A hub as recited in claim 1, said hub being formed by a powder metallurgy process.
15. A hub as recited in claim 14, said hub being formed by the steps of:
- a) providing a mold,
 - b) filling said mold with metal powder of suitable composition, particle size, and particle shape,
 - c) compacting said metal powder in said mold at suitable time and pressure to form a preform,
 - d) removing said preform from said mold,

- e) providing a non-oxidizing atmosphere, and
- f) applying heat to said preform at suitable time and temperature in said non-oxidizing atmosphere to sinter said metal powder.

- 5 16. A hub as recited in claim 15, wherein said metal powder is nickel steel powder having a composition by weight of 91.9% to 98.7% Fe, 1.0% to 3.0% Ni, 0.3% to 0.6% C, zero to 2.5% Cu, and any other elements taken together totaling no more than 2.0% maximum.
- 10 17. A hub as recited in claim 1, having an outer surface, said hub further comprising a hole communicating between said inner surface of said opening and said outer surface, said hole being tapped with internal threads for a setscrew.
18. A pulley comprising:
 - a) a hub as recited in claim 1, and
 - b) a disk-shaped body having a rim formed with a peripheral recess for receiving a pulley belt, said disk-shaped body being affixed to said hub.
- 15 19. A pulley as recited in claim 18, wherein said disk-shaped body is affixed to said hub by a weld.
- 20 20. A pulley as recited in claim 18, wherein said disk-shaped body is affixed to said hub by pressing.
21. A hub for a pulley, gear, or wheel, said hub having a first opening for a shaft, said first opening having an inner surface and first and second ends, said hub comprising:
 - a) means integral with said inner surface of said first opening for preventing relative rotation of said hub on said shaft when said hub is disposed on said shaft, and

b) an integral stop extending across at least a portion of one of said first and second ends of said first opening, for preventing said shaft from extending beyond said hub when said hub is disposed on said shaft.

22. A hub as recited in claim 21, said hub being formed by a powder metallurgy process.

5 23. A hub as recited in claim 21, said means integral with said inner surface comprising one or more flat surfaces.

24. A hub as recited in claim 23, said one or more flat surfaces together forming a first opening having a generally polygonal cross-section.

10 25. A hub as recited in claim 21, said means integral with said inner surface comprising one or more splines.

26. A hub as recited in claim 21, said hub having an outer peripheral surface portion concentric with said first opening, said outer peripheral surface portion having a right circular cylindrical form.

15 27. A hub as recited in claim 21, said hub having an outer peripheral surface portion concentric with said first opening, said outer peripheral surface portion having a right elliptical cylindrical form.

28. A hub as recited in claim 21, said hub having an outer peripheral surface portion concentric with said first opening, said outer peripheral surface portion having a pyramidal form.

20 29. A hub as recited in claim 21, said hub having an outer peripheral surface portion concentric with said first opening, said outer peripheral surface portion having a conical form.

30. A hub as recited in claim 21, said hub having an outer peripheral surface portion concentric with said first opening, said outer peripheral surface portion having a splined form.

31. A gear comprising:

- 5 a) a hub as recited in claim 1, and
 b) a disk-shaped body having a rim formed with gear teeth,
 said disk-shaped body being affixed to said hub.

32. A gear as recited in claim 31, wherein said disk-shaped body is affixed to said hub by a weld.

10 33. A gear as recited in claim 31, wherein said disk-shaped body is affixed to said hub by pressing.

ABSTRACT

A hub for a pulley, gear, or wheel is formed with an integral key or other integral means for preventing relative rotation and with an integral stop for positioning the hub axially on a shaft. The hub has a generally cylindrical opening for a shaft, an integral key extending inwardly into the shaft opening along at least part of the shaft opening for engaging a keyway in the shaft, and an integral mechanical stop covering at least a portion of one end of the shaft opening. The integral key preferably extends the entire length of the shaft opening. The mechanical stop preferably has an opening which is disposed at least around one end of the integral key. The mechanical stop serves to position the pulley, gear, or wheel precisely with respect to the end of a shaft when the pulley, gear, or wheel is assembled onto the shaft. The keyed hub is manufactured by powder metallurgy. One or more body plates are welded to the formed hub to form a pulley, gear, or wheel, or the hub is pressed into a body plate. The shaft opening may be formed with an integral flat or with a polygonal or splined cross-section to prevent rotation of the hub on its shaft, instead of, or in addition to, the integral key.

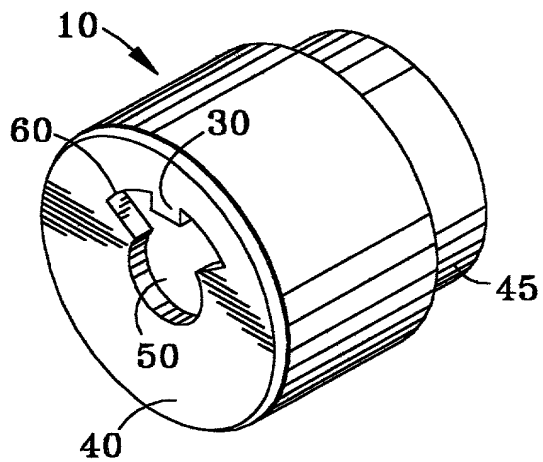


FIG. 1

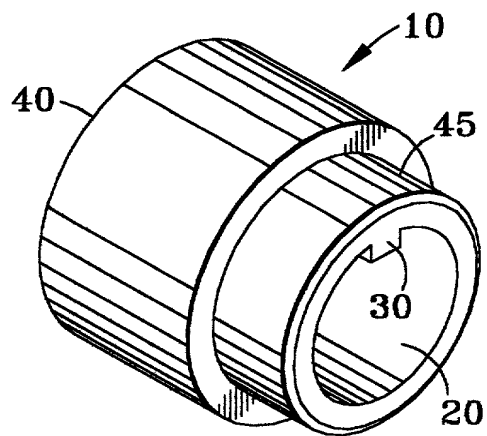


FIG. 2

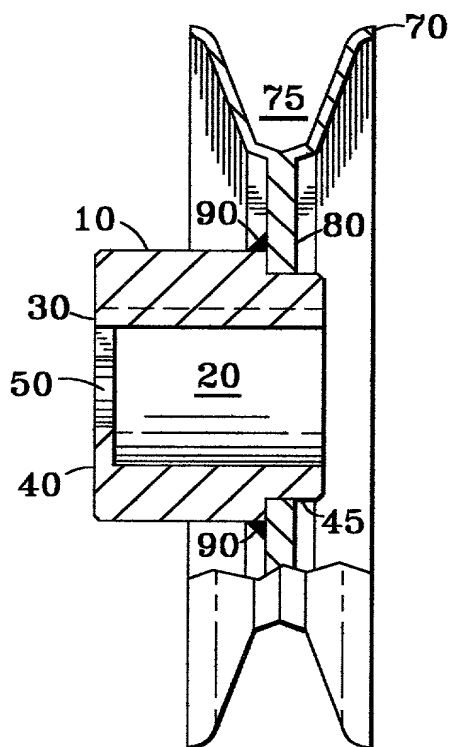


FIG. 3

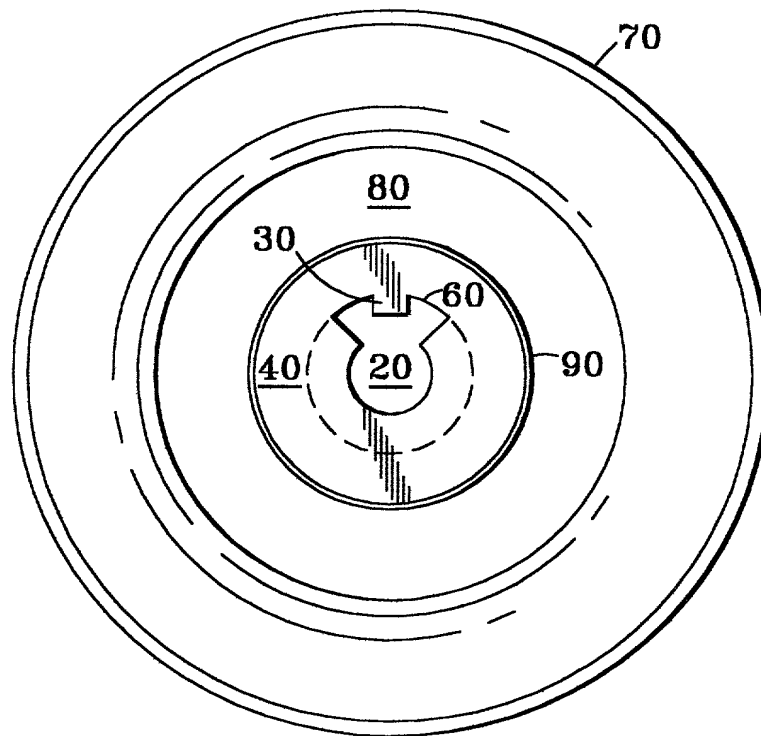


FIG. 4

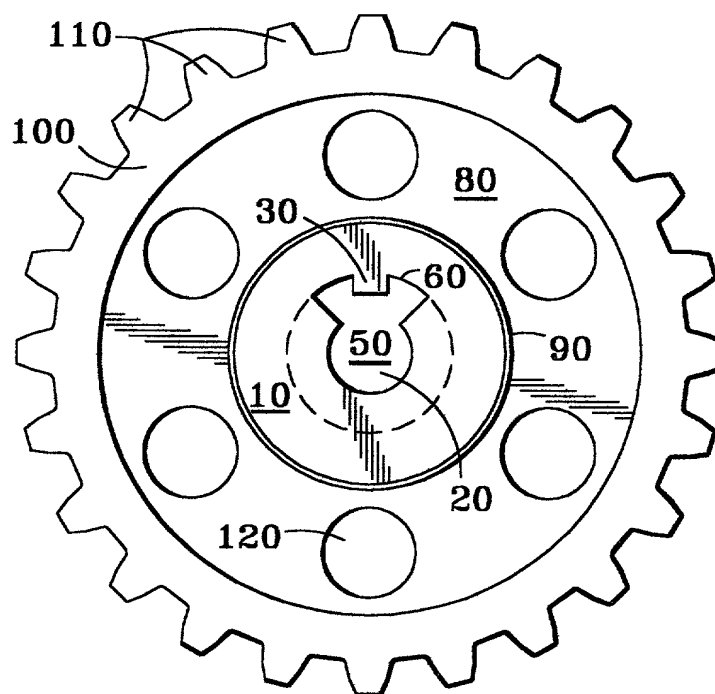
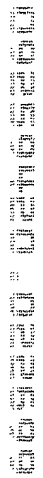
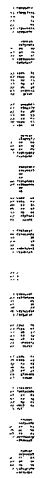


FIG. 5

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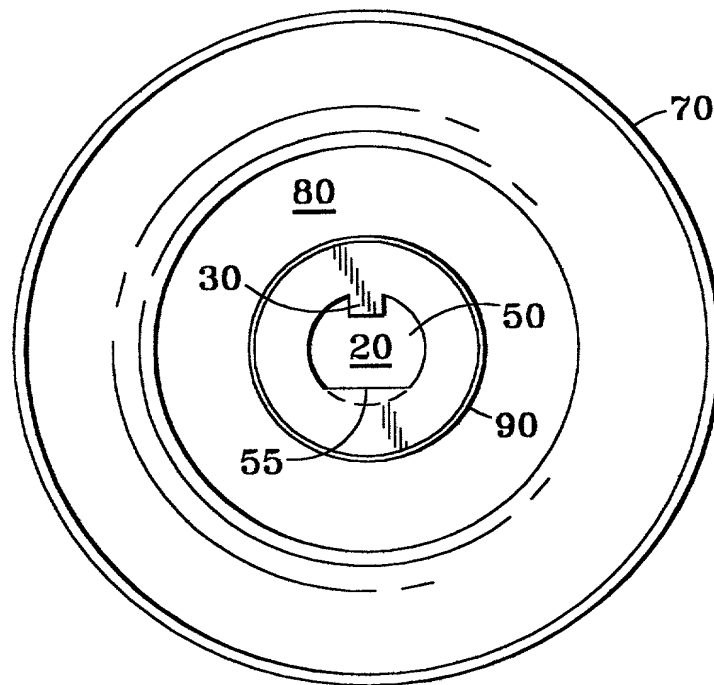


FIG. 8

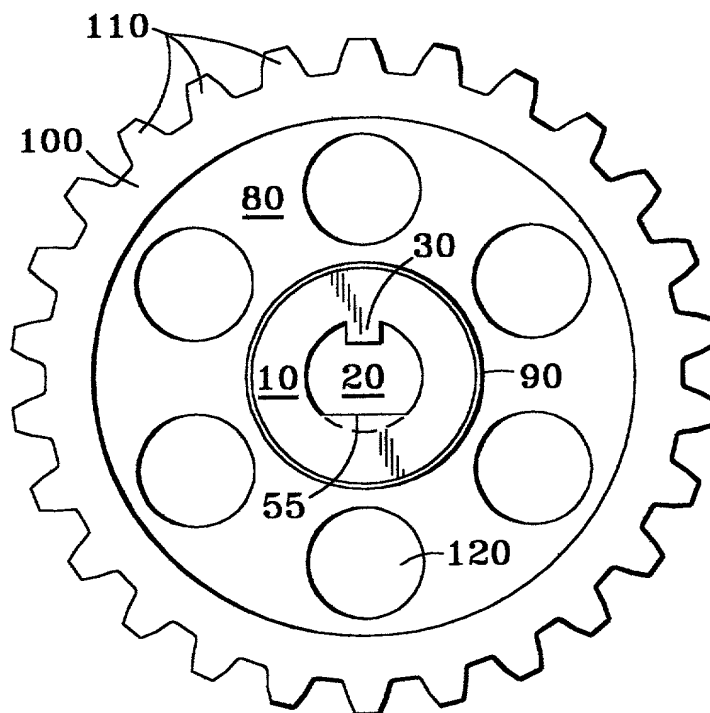


FIG. 9

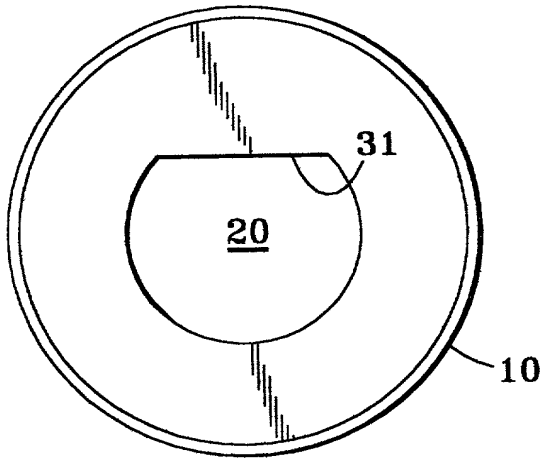


FIG. 10

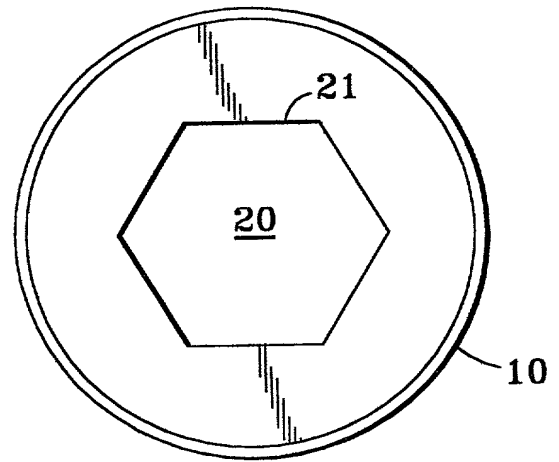


FIG. 11

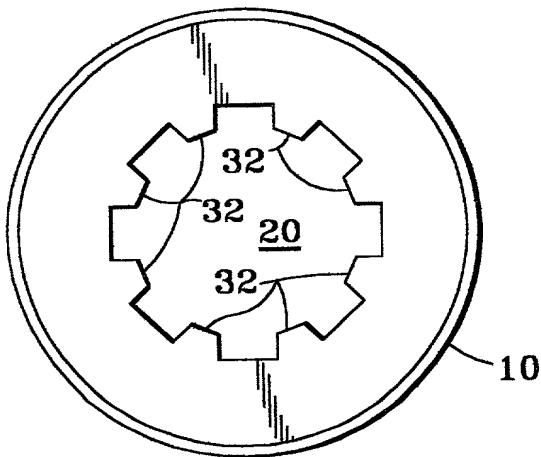


FIG. 12

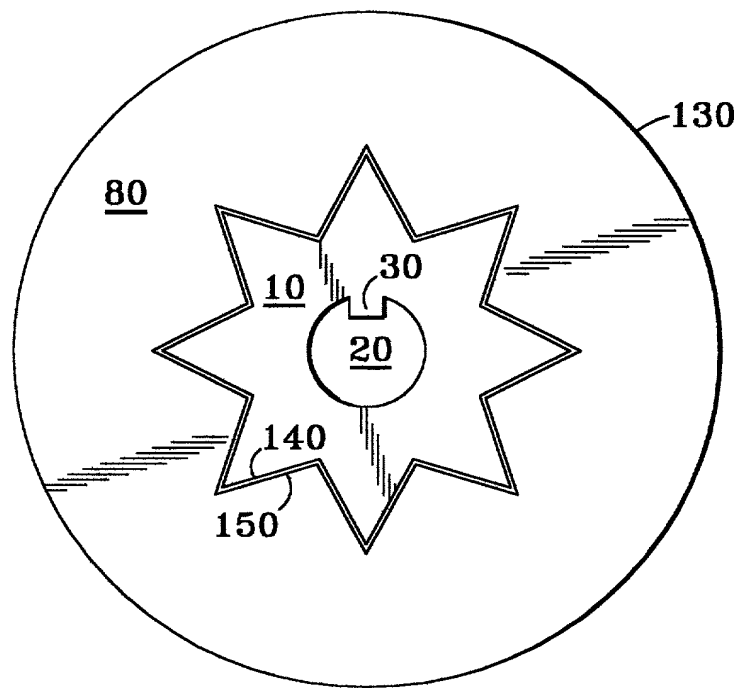


FIG. 13

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)	Attorney Docket Number	834DAW
	First Named Inventor	DAWSON, Tyler R.
	COMPLETE IF KNOWN	
	Application Number	/
	Filing Date	
	Group Art Unit	
<input checked="" type="checkbox"/> Declaration Submitted with Initial Filing OR <input type="checkbox"/> Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)	Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

HUB WITH INTEGRAL KEY AND INTEGRAL POSITIONING STOP

the specification of which (Title of the Invention)

☒ is attached hereto
OR

☐ was filed on (MM/DD/YYYY) as United States Application Number or PCT International

Application Number and was amended on (MM/DD/YYYY) (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?	
				YES	NO
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			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	<input type="checkbox"/> Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

[Page 1 of 2]

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DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO

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As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to tr and Trademark Office connected therewith:

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020143

OR

☐ Registered practitioner(s) name/registration number listed below



020143

Name	Registration Number	Name
Theodore R. Touw	36,702	

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to: ☐ Customer Number or Bar Code Label

OR ☒ Correspondence address below

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor:		<input type="checkbox"/> A petition has been filed for this unsigned inventor			
Given Name (first and middle [if any])		Family Name or Surname			
Tyler R.		Dawson			
Inventor's Signature				Date	2-10-99
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City		State	VT	ZIP	05495
				Country	U.S.A.

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